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HIGHLIGHTS OF 1977 ACTIVITIES

Two Voyager spacecraft were launched beginning a 10-year journey to the outer reaches of the solar system and, on Earth, two series of manned Space Shuttle Orbiter tests were successfully completed, highlighting the 1977 activities of the National Aeronautics and Space Administration.

The heaviest Earth-orbiting satellite ever launched, High Energy Astronomy Observatory, HEAO-A, also began its flight into space to study some of the most intriguing mysteries of the universe -- pulsars, quasars, exploding galaxies and black holes in space.

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Of the space agency's 16 launch efforts during the year, 13 were successful. Two of the failures resulted in the destruction of the launch vehicle and spacecraft immediately after liftoff. In the third case the upper stage of the launch vehicle did not operate properly and therefore the spacecraft was not put into the desired orbit.

Of the total, 12 of the launches, including the three failures, were reimbursable for which NASA is paid for the launch and launch support costs.

SPACE FLIGHT

Dominating space flight activities in 1977 were the dramatically successful flights of the Space Shuttle Orbiter, Enterprise.

In February, the 10-month-long series of low altitude flights to verify the aerodynamic and flight control characteristics of the first Shuttle Orbiter began at NASA's Dryden Flight Research Center, Edwards, Calif. Following several taxi tests of the modified Boeing 747 carrier aircraft with the Enterprise attached on top, the first flight of the mated pair occurred Feb. 18. This series of five captive inert flights (Orbiter unpowered and unmanned), which proved the flightworthiness of the combination, was followed by three captive active flights when the Orbiter systems were powered up and the Enterprise was manned alternately by two teams of NASA astronauts -- Fred W. Haise with C. Gordon Fullerton and Joe H. Engle with Richard H. Truly.

With the completion of the mated flights on July 26, the stage was set for the first free flight of the Enterprise. On schedule, Aug. 12, with Astronauts Haise and Fullerton at the controls, the 75-ton Enterprise was flown to an unpowered landing on the Edwards dry lake bed runway after explosive bolts had released the craft from its jumbo jet carrier aircraft at an altitude of 24,000 feet. The maiden free flight of the Orbiter took 5 minutes 22 seconds.

Subsequently, the Shuttle Orbiter was flown for two more free flights with its tailcone on which provided smooth airflow and reduced drag of the 747/Orbiter combination. Then on Oct. 12 with the tailcone removed and replaced with three simulated engines (the configuration that more nearly represents how the Orbiter will return from space) Joe Engle and Richard Truly flew the Enterprise for 2 minutes 34 seconds to a near-perfect lake bed landing.

The objective of the fifth and final free flight Oct. 26 was to land the Orbiter on a hard surface runway rather than the huge expanse of the dry lake bed. In a flight that lasted less than two minutes, Haise and Fullerton guided Enterprise to a safe landing on the Edwards runway.

Following several unmanned mated flights of the Orbiter and 747 combo in November in a ferry configuration, the Enterprise was being prepared at the end of the year for a cross country flight aboard the carrier aircraft to NASA's Marshall Space Flight Center, Huntsville, Ala., in March 1978.

While in 1977 the free flights of the Enterprise stole most of the Space Shuttle thunder, other elements of the total system were taking shape across the country.

Some of the more significant events occurring during the year included the successful test firing of the first solid rocket development motor on schedule in July at the Thiokol Plant in Utah. Three additional rocket motor tests are planned for next year.

A major milestone in the Shuttle program took place in September when the first completely assembled external tank (the huge fuel tank which will feed the Orbiter main engines) was rolled out at NASA's Michoud Assembly Facility, New Orleans. Immediately following roll-out, the tank was shipped to the National Space Technology Laboratories, Bay St. Louis, Miss., where it will be used in the main propulsion test program during 1978.

Six research and development Shuttle main engines have been delivered to the National Space Technology Laboratories and four have been tested. So far, over 13,000 seconds of operating time have been accumulated on the test engines.

Space Shuttle launch and landing facilities at the Kennedy Space Center, Fla., moved ahead at a fast clip. Work continued on the Shuttle launch pad, the mobile launch platform, work stations in the Vehicle Assembly Building, the Orbiter Processing Facility, Hypergolic Maintenance Facility, the Solid Rocket Retrieval and Disassembly Facility and the Rocket Parachute Facility. These facilities are now over 80 per cent complete and on schedule to support the first manned orbital flight in 1979.

Important progress in development of Spacelab, the versatile laboratory to be carried in the cargo bay of the Space Shuttle, was made by the European Space Agency during the year. Manufacture of the first flight unit was begun and it appears that the 1979 delivery date will be met.

The actual operation of the Space Transportation System (STS) began to take on more importance in 1977 with increasing activities in planning and establishing policies and procedures in running the STS. Space Shuttle user charge policies were published for commercial, foreign and civil government users early in 1977. A reimbursement agreement was also concluded with the Department of Defense in March. Operational procedures and management instructions are being developed defining ground-turnaround plans, crew training, flight operations, space center roles and responsibilities and financial management. In the area of payload planning, cargo manifests for 1980 and 1981 were developed based on firm payload commitments.

After a year long effort, NASA's recruiting for additonal astronauts came to an end in June. Altogether, NASA received 24,618 inquiries and 20,440 persons requested applications. By June 30 more than 8,000 applications had been received including 1,544 from women and at least 400 from minorities. This number was narrowed to 208 applicants who came to NASA's Johnson Space Center, Houston, Texas, for interviews and physical examinations during the second half of the year.

The final group of Space Shuttle pilots and mission specialist selectees are to be announced in January.

SPACE SCIENCE

NASA continued its systematic program of planetary exploration of the solar system with the launch in August and September 1977 of two Voyager spacecraft toward the outer reaches of the solar system. The 10-year odyssey will take the Voyagers past giant Jupiter, to ringed Saturn and probably to Uranus. Carrying a dozen scientific instruments and television cameras, spacecraft promise to return first-hand information on the giant planets that will give us exciting new clues to the early history of the solar system and our own planet Earth.

The Voyagers will spend a total of eight months examining Jupiter and its major satellites. Voyager 1 will make its closest approach to the planet March 5, 1979, and Voyager 2 will arrive four months later. Huge Jupiter's gravity will bend the flight paths of the two spacecraft, slinging them toward an encounter with ringed Saturn in 1980, including a close examination of Saturn's huge satellite Titan -- the only one in the solar system known to have a substantial atmosphere. Close observations of Titan by all Voyager's instruments are a prime project goal. If all is well, Voyager 2 will then be targeted for Uranus and its newly discovered rings and several satellites.

Both Voyagers will depart the solar system to journey nearly endlessly among the stars. On the chance that someone is out there, each of the Voyagers carries a phonograph record containing "Sounds of Earth" and electronic information that an advanced technological civilization could convert into pictures and diagrams.

The oft-delayed launch of NASA's first High Energy Astronomy Observatories, HEAO-1, took place in August, inaugurating a three-mission program to study some of the most intriguing mysteries of the universe -- pulsars, quasars, exploding galaxies and black holes in space.

Scheduled to survey the entire sky in six months, the two-ton Earth-orbiting observatory provided results in the first weeks, discovering a mysterious X-ray nova -- a gigantic star whose X-ray radiation increases violently over a period of time, then returns to normal, and a possible black hole in the constellation Circinus, deep in the southern sky. (A black hole is believed to be the final stage in the collapse of a dying star which was very massive. The collapsed star's material is so densely packed and the gravitational force so great that even light waves are unable to escape from the surface of a black hole. All external evidence of its presence disappears. The existence of a black hole has never been confirmed by direct observation, but it has been predicted by the laws of relativity.)

Other significant launches in 1977 included:

• International Sun Earth Explorers -- Two spacecraft were launched into Earth orbit by a single rocket as part of a cooperative program by NASA and the European Space Agency (ESA) to gain a better understanding of how the Sun controls the Earth's near space environment. Circling the Earth at varying trajectories for three years or more, the instrument-laden spacecraft are expected to provide detailed data on how solar wind particles control the boundaries between Earth space and interplanetary space. This will lead to a better understanding of a variety of solar-terrestrial phenomena, including weather and climate, energy production and ozone depletion in the atmosphere.

The beginning of 1977 marked the end of the normal missions of Vikings 1 and 2 on Mars, and the beginning of the "extended" missions that will permit scientific observations through an entire Martian year of 25 months. In February, Viking 1 orbiter cameras took the most detailed pictures yet of Mars' tiny moon Phobos from a distance of less than 48 kilometers (30 miles). Other experiments included taking more photographs of the Martian terrain, monitoring for seismic events, observing the planet's daily and seasonable weather changes, and subjecting more soil samples to life detection tests.

At year's end, plans were moving ahead for the late 1978 launch of Pioneer Venus, a multiprobe craft designed to provide the clearest pictures yet of the cloud-shrouded sister planet to the Earth. Work also was continuing toward the launch of Spacelab by the Space Shuttle in 1980, the Jupiter Orbiter Probe in early 1982 and the Space Telescope in 1983.

SPACE APPLICATIONS

With the reorganization and restructuring of NASA's program offices late in 1977, and to better describe the scope of its programs, the Office of Applications became the Office of Space and Terrestrial Applications (OSTA).

Landsat, one of OSTA's premier programs, continued making history as the first satellite ever launched to focus specifically on the Earth and its natural resources.

Launched July 23, 1972 -- with a life expectancy of only one year -- Landsat 1 observed its fifth anniversary recording and transmitting to Earth the unique signatures radiated by land, minerals, vegetation and man-made structures. It was joined by a second such satellite, Landsat 2, Jan. 22, 1975.

Typical of Landsat projects undertaken in 1977 were:

- The creation of a geologic map of Minnesota covering 84,000 square miles at a cost of $.65 per square mile, compared with a cost of $118 per square mile using previous methods. Such a geologic map is important for direct use by regional planners, environmentalists, civil engineers, foresters, soil scientists, agronomists, recreation specialists and hydrologists.

- An agreement with the St. Regis Paper Co. to determine the technical and economic feasibility of monitoring that company's 1.7 million acres of timberland in Alabama, Florida, Georgia, Louisiana and Mississippi.

- The mapping of a major portion of Upper Volta to locate potential settlement areas.

Other ways in which Landsat data are being used include measuring crop acreages, mapping snow cover, detecting oil slicks, mapping urban and agricultural land use, detecting offshore dumping of sewage and industrial waste, mapping mineral areas, monitoring the environmental effects of strip mining and locating potential earthquake zones.

This project was accomplished in one-quarter of the time and at one-tenth of the cost of an aerial survey.

A NASA-developed coliform monitoring system to rapidly detect bacterial contamination in water was tested in a field experiment in the waters of the New York right off Caven Point, N.J.

The system uses electronic sensors developed as a by-product of early Skylab environmental control systems technology and would permit health authorities to act promptly in the event large quantities of disease-producing bacteria are discovered. A preliminary assessment of the system indicated that six out of eight sensors tested successfully. Further evaluations are currently under way by NASA and the Environmental Protection Agency.

Another system developed by OSTA is an airborne thermal infrared scanning system to detect heat loss from buildings. This system was demonstrated successfully in selected residential areas of Cleveland, Ohio, and Springfield, Ill.

Preparing for the 1980s, when the new era of the space Shuttle Transportation System (STS) will begin service, OSTA selected 14 materials processing experiments to fly on STS Flights 16 and 18. The experiments, managed by the Marshall Space Flight Center, over a longer period, are expected to lead to privately funded research and manufacturing operations in space.

The Communications Technology Satellite (CTS) which NASA shares with the Canadian Department of Communications (DOC) continued its pioneering methods of providing communications services in the fields of medicine, education, community interaction, data collection and broadcasting.

One cooperative experiment between NASA and Canada's DOC is enabling engineering students at Stanford University near the Ames Research Center in California to take courses some 2,500 miles away televised by Carleton University in Ottawa, Ontario, Canada and vice versa.

CTS proved its versatility during the Johnstown, Pa., flood in July when it was teamed with a Comsat-developed transportable Earth terminal to be used in times of natural disaster to provide reliable communications. A Comsat report of the operation states: "For two days messages were handled nearly continuously through the small terminal without disruption."

The report also cited "excellent cooperation Comsat and the Red Cross received from the NASA-Lewis CTS Program Office."

ATS-6, launched in May 1970 is still operating successfully as one of the world's most powerful communications satellites.

AERONAUTICS

Environmentally acceptable, safer, more energy efficient aircraft that provide better public service are broad goals of NASA's aeronautical research and technology development program.

A principal focus is aircraft energy efficiency to curb fuel consumption. This work embraces engine research, improved aerodynamic shapes, computerized flight control systems and lighter aircraft structure, all of which influence fuel expenditures. Collectively, these technologies could cut fuel consumption up to 50 per cent in future generation aircraft.

Vertical and short takeoff and landing aircraft research and technology work is aimed at improving performance and quieter operations. The NASA Tilt Rotor Research Aircraft and the Rotor Systems Research Aircraft both progressed into the flight testing phase this year while NASA's Quiet, Shorthaul Research Aircraft neared construction completion.

Studies and research for high-speed flight, leading to technology development for future civil and military aircraft, also yielded promising results during 1977.

The safety and utility of single- and twin-engined general aviation aircraft are being improved by NASA studies, tests and technology advancements. Additionally, NASA established a General Aviation Design and Analysis Center at Ohio State University, under a three-year contract to provide services directly to aircraft designers and manufacturers.

The NASA aeronautical work included fire-resistant materials research; collision avoidance research; studying techniques for warning pilots of potentially troublesome clear air turbulence; conducting light airplane crash tests with an eye toward greater passenger protection; and accident prevention through aviation safety incident reporting and analysis.

TECHNOLOGY UTILIZATION

NASA's Technology Utilization Program marked its 15th anniversary during 1977. Since its inception, this unique program has served as the agency's focal point for the transfer of aerospace technology into other sectors of the national economy.

Hundreds of new products and techniques -- affecting virtually every scientific and technical discipline -- have become part of our everyday lives as a result of the program.

The following statistical highlights for 1977 give an insight into the scope of this increasingly important effort:

- Reports indicate that more than 12,000 clients were serviced by the seven regional and two new state (Florida and Kentucky) Industrial Applications Centers -- an increase of 20 per cent over the previous year.

- A broad-based program of 60 applications engineering projects was continued in the on-going effort to apply aerospace technology and know-how to solve public sector problems ranging from development of advanced medical instruments to fire-fighting devices.

- A total of 475 new items of technology were announced in the quarterly Tech Brief Journal.

In August, a family of four moved into the NASA Tech House at the Langley Research Center, Hampton, Va. This one-of-a-kind house features solar heating, partial waste water reclamation and numerous comfort and safety innovations, many of them derived from aerospace research. The family will live in the house for one year in a controlled test of utilities usage, the practicality of the home's innovative features and its livability.

Preliminary data, collected by Langley engineers before the end of the year, indicate there is considerable cost savings in the use of the basic utilities -- electricity and water -- and that the family finds living in the house pleasant.

A major applications engineering program got underway early in the year when NASA and the National Fire Prevention and Control Administration (NFPCA) undertook a comprehensive, long-term cooperative program to apply aerospace technology and techniques to develop lighter, tougher and safer equipment for U.S. fire-fighters.

Called Project FIRES (for Firefighters Integrated Response Equipment System), the effort is aimed at improving firefighters' protection against such hazards as heat, flame, smoke, toxic fumes and electrical shock while also permitting improved performance and greater maneuverability. The program is being directed for NASA by the Marshall Space Flight Center, Huntsville, Ala. During the initial phases new standards for equipment are being developed. These standards will then be applied in the design and fabrication of a complete firefighter's ensemble. The effort is being monitored by a User Requirements Committee composed of firefighters, fire chiefs, safety officials and technical consultants from throughout the country.

In March, NASA, through the Marshall Center, established a Manufacturing Applications Team at the Illinois Institute of Technology Research Institute in Chicago. This new organization is charged with reviewing NASA-developed technology to identify techniques or processes that may be useful in solving problems unique to the manufacturing industry. Initially, the team is concentrating on problems relating to the manufacturing of machine tools, heavy equipment, electronics assembly and light fabrication and assembly.

In the medical field, NASA's Johnson Space Center, Houston, designed and built a prototype emergency services communications unit now being tested by the Odessa Medical Center Hospital, Odessa, Texas, a regional "control center" hospital in the 17-county Permian Basin Emergency Medical System. The compact communications system, built from "off the shelf" electronic components, permits a physician or nurse to consult by radio with ambulance drivers and paramedics as well as other hospitals and to receive electrocardiograms as well as set up radio-to-telephone patches and page hospital staff members throughout the area. The need for an integrated emergency medical communications system is recognized as an essential part of medical services systems which permits on-the-scene medical treatment and during transfer to hospitals. Results of the experiment will be made available to the U.S. medical community.

Finally, at the Goddard Space Flight Center, a handheld X-ray device powered by a single pen-size battery which produces an instant image with a small source of radio-activity, has been developed from instrumentation used to study X-ray sources in space and an image intensifier developed by the Army's Night Vision Laboratory, Ft. Belvoir, Va. Called the Lixiscope (for Low Intensity X-ray Imaging Scope), the new device appears to have great potential for use in the medical and dental fields.

INTERNATIONAL

In 1977 NASA's international activity highlights included: three new bilateral cooperative program agreements, payload selections for early Spacelab flights, steady progress in Spacelab and Remote Manipulator System development programs abroad, a series of international reimbursable launches and continuing progress in space applications programs in the remote sensing and communications fields.

Three new international cooperative space agreements were of particular interest. Officials in the Federal Republic of Germany entered into an agreement with NASA to take an important part in a Jupiter Orbiter Probe (JOP) mission, scheduled for early 1982. JOP is designed to conduct the most detailed scientific investigation yet of Jupiter, its environment and moons, including the first direct measurements of the planet's atmosphere.

NASA and The Netherlands Agency for Aerospace Programs (NIVR) entered into an agreement for a cooperative Infrared Astronomical Satellite project (IRAS). The United Kingdom also will participate in this program. Scheduled for launch in 1981, the IRAS mission will conduct the first astronomical survey of the entire sky at infrared wavelengths undetectable by Earth-based telescopes because of the obscuring effects of the atmosphere.

The European Space Agency (ESA) signed an agreement with NASA for substantial contributions to and participation in an extended Space Telescope program. An earth orbiting 2.4-meter space telescope will be launched in 1983 by NASA's Space Shuttle and will be used to study the universe with much higher resolution than has ever been possible. With the Space Telescope, astronomers should be able to observe some 350 times more volume of space than can be seen now with the largest ground-based telescope.

Emphasis on future international use of the Space Transportation System (STS) continued in 1977. Following the successful completion of the Preliminary Design Review, the Spacelab program is proceeding on schedule toward the next milestone, the Critical Design Review, planned for early 1978.

The final selection of the Spacelab I payload complement was made in February 1977. Two hundred and twenty-two scientists, representing the U.S. and 15 other countries, were selected to participate in the flight which is scheduled for 1980. The group was selected from more than 2,000 candidates by NASA and the European Space Agency (ESA). The primary objective of the first flight is to verify the performance of Spacelab systems and subsystems, and to measure the environment surrounding the Shuttle.

Following the successful Preliminary Design Review of the Remote Manipulator System for the Shuttle Orbiter being built by Canada, the program moved on schedule toward the next milestone, the Critical Design Review, in April 1978.

In response to 14 Announcements of Opportunities put out by NASA in 1977, there were 51 foreign proposals for flight experiments received. These included two major British astronomy experiments which were selected for inclusion aboard NASA's Spacelab II.

A total of 18 "Get-away Specials," i.e., small scientific research packages, have been confirmed for early Shuttle flights by foreign countries and companies.

The International Sun Earth Explorers (ISEE-A & B) comprised NASA's 26th international cooperative launch. Two spacecraft were launched by a single rocket as part of a joint program by NASA and the European Space Agency (ESA). The objective of the program is to gain a better understanding of how the Sun controls the Earth's near space environment. In addition to ISEE, four other cooperative satellites remained active and returning data in 1977.

NASA's agreement with the Aerospace Research Center of the University of Rome for the next generation of San Marco satellites is developing as planned. San Marco D, to be launched in 1980, is expected to contribute importantly to the current study of the Earth's ozone layer.

Reimbursable launches during the year accounted for almost two-thirds of all NASA launches (10 of 16). Of these, three were successful launches of the communications satellites for NATO (NATO-III), Indonesia (Palapa-B) and Comsat (Intelsat IVA-C). Two communications satellite launches, ESA's Orbital Test Satellite (OTS) and Comsat's Intelsat IVA-D, failed. Back-up launches for both are scheduled in 1978.

Meteorological satellites were launched for Japan (GMS) and the European Space Agency (Meteosat). SIRIO-A was placed into orbit for Italy for microwave propagation studies. A second scientific satellite, GEOS (ESA), failed to reach correct orbit. The tenth launch was a communications satellite for Japan on Dec. 14.

Of the 22 launches currently scheduled by NASA for 1978, eight will be reimbursable.

To date, data obtained by NASA's Landsat satellites have been used in research projects sponsored by agencies in some 50 countries and international organizations. In addition, users from more than 100 countries have purchased Landsat data from the EROS Data Center at Sioux Falls, S.D.

Landsat ground stations now operate in Canada, Brazil, and Italy receiving data directly from U.S. satellites. A station is under construction in Iran and others are planned in Argentina, Chile, Sweden and Zaire. Japan, Australia and India are also seriously considering establishment of Landsat Stations.

A technical and social evaluation of the Satellite Instructional Television Experiment (SITE) was completed during the year. The Indian Space Research Organization (ISRO) presented the results to NASA at a November meeting in India. A number of lessons were learned including the efficacy of various types of programs; the use of inexpensive portable equipment for decentralized participatory program production; and the problems of programming in situations where rural and urban audiences are mixed. Partly as a result of the success of the experiment, India has committed to launching a communications satellite (INSAT) from Shuttle, the first foreign government to do so.

NASA has made good progress toward the test and demonstration of a Search and Rescue satellite system for the location and assistance of distressed aircraft and ships. The project has been planned with Canada and the Soviet Union has agreed to participate. A proposal has also been received from France to join in this project. Wide international use of such a Search and Rescue System could be anticipated after the initial experimental phase.

In November, NASA met with the USSR Academy of Sciences at the Space Research Institute in Moscow. The meeting was devoted to a discussion of questions of further cooperation between the U.S. and the Soviet Union in the area of manned space flight. The discussions were in accordance with the agreement of May 11, 1977, between the USSR Academy of Sciences and NASA. Two joint working groups of Soviet and American scientists and specialists carried out a preliminary discussion of possible joint research and experiments using a Soviet orbital station of the Salyut type and an American Shuttle spacecraft. Agreement was reached to continue the discourse on scientific and technical questions connected with preparations for a possible joint project.

ENERGY PROGRAMS

NASA's energy program is aimed at effectively using aeronautical and space capabilities in direct support of national energy research and development needs as well as determining how the unique characteristics of the space environment may be exploited to help solve energy-related problems on Earth.

In support of the U.S. Department of Energy's national solar heating and cooling demonstration program, the world's largest solar energy cooling system was dedicated at the Frenchman's Reef Holiday Inn, on the island of St. Thomas, Virgin Islands. With its 1,210 square meters (13,000 square feet) of solar collectors, the system is providing a large portion of the air conditioning requirements for the 300-room hotel.

In wind turbine generator support of the Department of Energy, a 200 kilowatt wind turbine has been constructed and prepared for initial operation early next year at Clayton, N.M. NASA has also contracted with industry to design, build, and test a 2.5 megawatt wind turbine generator. This wind turbine will employ blades that are 90 meters (300 feet) in diameter.

Other NASA research and development work during the year included photovoltaics, advanced ground propulsion, energy conversion and storage systems, gas turbines, fuel cell and hydrogen systems, magnetohydrodynamics, advanced coal energy extraction, and combustion, materials and heat exchanger technology.

NASA attempted 16 launches during 1977 and three of these were unsuccessful. Two of the failures resulted in the spectular destruction of the launch vehicles and spacecraft about a minute after liftoffs from Cape Canaveral. One was a Delta rocket, the other an Atlas-Centaur. A third failure resulted when the upper stage of the Delta launch vehicle did not operate properly with the result that the spacecraft was not put into the desired geosynchronous orbit.

Of the 16 launches, an even dozen, including the three failures, were in the reimbursable catagory--the payload sponsor paid NASA for the launch and launch support operations costs. Under this plan NASA makes "a best effort" and is paid even if the launch is a failure.

Two of the launches sent NASA Voyager payloads on missions to Jupiter and Saturn. One launch, ISEE 1 and 2 was a joint NASA-European Space Agency mission.

Ten of the 1977 launches were by Delta launch vehicles, two by Titan III Centaurs, three by Atlas-Centaurs and one by the Scout rocket.

The 1977 launch record brings to 345 the successful launches since NASA was established in 1958. During this period there were 58 failures.

1977 LAUNCHES

Launch Date	Name	Vehicle	Launch Site	Mission Remarks
Jan. 27	NATO-3 B	Delta	Cape Canaveral	Second communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
March 10	Palapa-2	Delta	Cape Canaveral	Back-up satellite for Indonesian domestic communications network. Reimbursable.
April 20	GEOS/ESA	Delta	Cape Canaveral	ESA spacecraft to conduct scientific investigation of waves and particles in magnetosphere. Reimbursable. Failed to reach correct orbit.
May 26	Intelsat IVA-C	Atlas/Cen.	Cape Canaveral	Improved communications satellite for Comsat. Reimbursable.
June 16	GOES/NOAA	Delta	Cape Canaveral	Second operational satellite to provide continuous daytime and nighttime global cloud cover observation for NOAA. Reimbursable.
July 14	GMS-Japan	Delta	Cape Canaveral	Geosynchronous Meteorological Satellite. Japanese portion of global network of geostationary environmental satellites. Reimbursable.
Aug. 12	HEAO-A	Atlas/Cen.	Cape Canaveral	High Energy Astronomical Observatory to study energetic radiation from space.

Launch Date	Name	Vehicle	Launch Site	Mission Remarks
Aug 25	SIRIO-I	Delta	Cape Canaveral	Italian project to investigate radio propagation, trapped radiation flux, magnetic field intensity and variation, and the primary electron energy spectrum. Reimbursable
Aug. 20	Voyager 2	Titan III Centaur	Cape Canaveral	Jupiter and Saturn planetary systems and the interplanetary medium out to Saturn.
Sept. 5	Voyager 1	Titan III Centaur	Cape Canaveral	Same as above.
Sept. 13	OTS/ESA	Delta	Cape Canaveral	Orbital Test Satellite. ESA experimental communication satellite. Reimbursable. Rocket exploded about a minute after launch.
Sept. 29	Intelsat IVA-D	Atlas/Cen.	Cape Canaveral	Follow-on series of improved communications satellites for Comsat. Reimbursable. Rocket exploded 55 seconds into flight.
Oct. 22	ISEE-A/B	Delta	Cape Canaveral	NASA's international Sun-Earth explorer. (Cooperative with European Space Agency)
Oct. 28	Navy Transat	Scout	Vandenberg AFB	Navy navigation satellite. Reimbursable.

Launch Date	Name	Vehicle	Launch Site	Mission Remarks
Nov. 22	Meteosat/ESA	Delta	Cape Canaveral	ESA meteorological satellite. Reimbursable.
Dec. 14	CS/Japan	Delta	Cape Canaveral	Communications satellite for Japan, to cover telephone and color TV transmission, and experiments. Reimbursable.